APPENDIX A

CALCULATIONS & ASSUMPTIONS

PASSENGER TRIPS

The number of passenger trips by mode for the 2020 No-Project Alternative came directly from the baseline intercity trip projections in the *Independent Ridership and Passenger Revenue Projections for High-Speed Rail Alternatives in California* (*Ridership Report,* California Highspeed Rail Auhority 2000), prepared for the Authority by Charles Rivers Associates (CRA). Under the Modal Alternative, the Authority's Business Plan assumes that 1.1% of No-Project intercity automobile trips would be induced to travel. Modal Alternative improvements to air travel infrastructure would allow a concentration of trips within the peak period of demand for air travel, but would not induce additional demand for passenger trips. Therefore, the number of passenger trips by commercial aircraft would not change as a result of implementing the Modal Alternative. The number of passenger trips by mode for the HST Alternative scenario was determined using the *Ridership Report*, which predicts the number of intercity trips that would be diverted from each of the conventional modes to the HST mode. Various intercity trip-diversion scenarios were forecasted by CRA, two of which were analyzed in this report: 1) Business Plan Funding Scenario Alternative (Base Forecast) and 2) Sensitivity Analysis for Business Plan Funding Scenario Alternative (Sensitivity Analysis), which includes a combination of growth of automobile and air travel, and increased travel time and air fares in addition to the Base Forecast (combination 6 (b) from Table 4-13 of the *Ridership Report*). The diverted intercity trips under both of the CRA scenarios selected for analysis were subtracted from the baseline intercity trip projections for each mode, resulting in the total number of intercity trips by mode expected for the HST Alternative under each of the demand scenarios. In addition to the intercity trips that the HST Alternative is expected to draw, CRA predicts that an additional 10 million long-distance commute trips by automobile passengers would be diverted to the HST system. Table A-1 shows the derivation of passenger trips.

Table A-1: Passenger Trips

	Baseline Trips[1]	Change in Baseline Passenger Trips	Passenger Trips
No-Project[2]			
Auto	181,110,689	0	181,110,689
Air	25,624,530	0	25,624,530
Modal			
Auto[3]	181,110,689	1,992,218 (1.1% of No-Project Auto)	183,102,907
Air[4]	25,624,530	0	25,624,530
HST (Sensitivity Analysis)			
Auto (Intercity)	181,110,689	-29,276,437	151,834,252
Auto[5] (Commute)	N/A[6]	-10,000,000	-10,000,000
Air	25,624,530	-25,368,285	256,245
HST (Intercity)	0	58,397,253	58,397,253
HST (Commute)	0	10,000,000	10,000,000
HST (Base Forecast)			
Auto (Intercity)	181,110,689	-14,378,554	166,732,135
Auto[5] (Commute)	N/A[6]	-10,000,000	-10,000,000
Air	25,624,530	-15,429,817	10,194,713
HST (Intercity)	0	32,001,428	32,001,428

HST (Commute)	0	10,000,000	10,000,000

[1]From the *Ridership Report* (California Highspeed Rail Authority 2000).
[2]No-Project Alternative assumes CRA Baseline intercity passenger trips.
[3]Assumes an inducement to travel of 1.1% of No-Project trips. Demand would be satisfied at a better level of service.
[4]Assumes no demand inducement. Demand would be satisfied at a better level of service.
[5]Values represent change from No-Project and are not absolute values. The total number of No-Project commute auto trips is not known.
[6]Total number of statewide Baseline commute-related trips is not known. Therefore, the absolute number of commute-related trips with implementation of the HST Alternative is not known. The change in the number of commute-related trips is noted.

VEHICLE MILES TRAVELED (VMT)

VMT were calculated based on projections of passenger trips by mode, average vehicle occupancy rates, and average trip distance per vehicle trip. Conventional rail passenger trips and associated VMT were omitted because of the relatively limited use of this mode for intercity travel. Table A-2 shows the derivation of VMT.

Table A-2: VMT

	Passenger trips[1]	Passenger trips/ Vehicle trip	Vehicle trips	Vehicle miles/trip	VMT
No-Project					
Auto[2]	181,110,689	2.4	75,462,787	250[7]	18,865,696,771
Air[3]	25,624,530	101.25	253,082	403	101,991,956
Modal					
Auto[2]	183,102,907	2.4	76,292,878	250[7]	19,073,219,435
Air[3]	25,624,530	101.25	253,082	403	101,991,956
HST (Sensitivity Analysis)					
Auto[4] (Intercity)	151,834,252	2.4	63,264,272	250[7]	15,816,067,906
Auto[4,5] (Commute)	-10,000,000	1.0	-10,000,000	51	-509,207,783
Air[3]	256,245	101.25	2,531	403	1,019,920
HST[6] (Intercity)	58,397,253	1,174	49,710	442	21,965,510
HST[6] (Commute)	10,000,000	1,372	7,291	242	1,763,552
HST (Base Forecast)					
Auto[4] (Intercity)	166,732,135	2.4	69,471,723	250[7]	17,367,930,763
Auto[4,5] (Commute)	-10,000,000	1.0	-10,000,000	51	-509,207,783
Air[3]	10,194,713	101.25	100,689	403	40,577,476
HST[6] (Intercity)	32,001,428	644	49,710	442	21,965,510
HST[6] (Commute)	10,000,000	1,372	7,291	242	1,763,552

[1]From Table A-1.

[2]Automobile VMT for No-Project and Modal Alternatives were calculated indirectly by dividing the sum of HST-diverted intercity automobile VMT by the change in the forecasted number of intercity automobile passenger trips, which resulted in an average intercity automobile vehicle trip length across the five air basins of 250 miles. This value was assumed to hold for the No-Project and Modal Alternative scenarios and multiplied by the projected number of intercity automobile trips for each to get automobile VMT. The assumption of 2.4 passenger trips per vehicle trip was taken from the *Project Description*.

[3]Air VMT were calculated by assuming a 70% load factor for a 145-passenger aircraft, or an average of 101.25 passengers per airplane trip, and an average trip length of 403 miles (*Project Description*).

[4]Automobile VMT for the HST Alternative were calculated directly by Kaku Associates, where the statewide intercity and long-distance commute VMT, resulting from automobile trips diverted to HST, were obtained by summing the VMT that were assumed to occur within the study area, defined as the five air basins where the majority of long-distance commute and intercity automobile travel would occur in 2020.

[5]The passenger trip value represents change from No-Project and not an absolute value.

[6]HST Alternative VMT and vehicle trips were derived from the Business Plan. The Passengers per train-trip and the length of the average train trip were inferred based on the passenger trip, vehicle trip, and VMT values.

[7]Average value, as calculated using Kaku's VMT values for each ridership scenario in the HST Alternative case, the representative demand for auto under each scenario, and the average vehicle occupancy (2.4). Actual value was 248 and 253 vehicle-miles/trip for Base Forecast and Sensitivity Analysis cases, respectively. The average value of 250 vehicle-miles/trip was used for consistency and applied to the No-Project/No-Action Alternative and Modal Alternative cases.

DIRECT ENERGY CONSUMPTION

Table A-3 shows how energy consumption was calculated based on VMT values for each of the modes in the study, as well as, the way in which the HST and Modal System Alternatives affect energy consumption in absolute and percentage terms compared to Existing (1997) and No-Project conditions. Energy consumption is reported in terms of British Thermal Units (Btus) and barrel-of-oil equivalents. This method of determining direct energy consumption is described in the Energy Technical Report.

Table A-3: Direct Energy Consumption

ALTERNATIVE	Existing (absolute)	No-Project (absolute)	No-Project (absolute, 5% elevated auto consumption factor)	Modal (absolute)	HST (absolute)	HST (change from No-Project auto & HST commute trips)
Sensitivity Analysis Case						
VMT by Mode[1]						
Annual Auto VMT	14,237,282,292	18,865,696,771	18,865,696,771	19,073,219,435	15,816,067,906	-509,207,783
Annual Airline VMT	62,302,749	101,991,956	101,991,956	101,991,956	1,019,920	
Annual HST VMT	0	0	0	0	21,965,510	1,763,552
Direct Energy by Mode						
Annual Auto Direct Energy[2] (Btu)	80,711,153,311,458	106,949,634,993,854	112,297,116,743,547	108,126,080,978,787	89,661,288,956,362	-2,886,698,923,244
Annual Airline Direct Energy[2] (Btu)	20,814,476,274,181	34,074,084,760,699	34,074,084,760,699	34,074,084,760,699	340,741,041,300	
Annual HST Direct Energy[3] (Btu)	0	0	0	0	20,304,566,128,951	1,630,199,000,536
System-wide Direct Energy						
TOTAL DIRECT ENERGY (Btus)	101,525,629,585,639	141,023,719,754,553	146,371,201,504,246	142,200,165,739,485	110,306,596,126,613	
Change from Existing Direct Energy (Btu)		39,498,090,168,914	44,845,571,918,607	40,674,536,153,846	8,780,966,540,974	-1,256,499,922,709
% Change in Existing Direct Energy (Btu)		0.39	0.44	0.40	0.09	
Change from No-Project Direct Energy (Btu)				1,176,445,984,932	-30,717,123,627,940	-1,256,499,922,709
% Change in No-Project Direct Energy (Btu)				0.01	-0.22	
Change from No-Project Direct Energy (5% increase in energy consumption factor) (Btu)				-4,171,035,764,760	-36,064,605,377,633	
% Change in No-Project Direct Energy (5% increase in energy consumption factor) (Btu)				-0.03	-0.25	
TOTAL DIRECT ENERGY (BARRELS OF OIL)[5]	17,504,419	24,314,434	25,236,414	24,517,270	19,018,379	
Change from Existing Direct Energy (Barrels of Oil)		6,810,016	7,731,995	7,012,851	1,513,960	-216,638
% Change in existing Direct Energy (Barrels of Oil))		0.39	0.44	0.40	0.09	
Change from No-Project Direct Energy (Barrels of Oil)				202,836	-5,296,056	-216,638
% Change in No-Project Direct Energy (Barrels of Oil)				0.01	-0.22	
Change from No-Project Direct Energy (5% increase in energy consumption factor) (Barrels of Oil)				-719,144	-6,218,035	
% Change in No-Project Direct Energy (5% increase in energy consumption factor) (Barrels of Oil)				-0.03	-0.25	

Investment Grade Case						
VMT by Mode[1]						
Annual Auto VMT	14,237,282,292	18,865,696,771	18,865,696,771	19,073,219,435	17,367,930,763	-509,207,783
Annual Airline VMT	62,302,749	101,991,956	101,991,956	101,991,956	40,577,476	
Annual HST VMT	0	0	0	0	21,965,510	1,763,552
Direct Energy by Mode						
Annual Auto Direct Energy[2] (Btu)	80,711,153,311,458	106,949,634,993,854	112,297,116,743,547	108,126,080,978,787	98,458,799,494,865	-2,886,698,923,244
Annual Airline Direct Energy[2] (Btu)	20,814,476,274,181	34,074,084,760,699	34,074,084,760,699	34,074,084,760,699	13,556,366,532,972	
Annual HST Direct Energy[6] (Btu)	0	0	0	0	17,258,873,741,335	1,385,668,550,848
System-wide Direct Energy						
TOTAL DIRECT ENERGY (Btus)	101,525,629,585,639	141,023,719,754,553	146,371,201,504,246	142,200,165,739,485	129,274,039,769,172	
Change from Existing Direct Energy (Btu)		39,498,090,168,914	44,845,571,918,607	40,674,536,153,846	27,748,410,183,533	-1,501,030,372,397
% Change in Existing Direct Energy (Btu)		0.39	0.44	0.40	0.27	
Change from No-Project Direct Energy (Btu)				1,176,445,984,932	-11,749,679,985,381	-1,501,030,372,397
% Change in No-Project Direct Energy (Btu)				0.01	-0.08	
Change from No-Project Direct Energy (5% increase in energy consumption factor) (Btu)				-4,171,035,764,760	-17,097,161,735,074	
% Change in No-Project Direct Energy (5% increase in energy consumption factor) (Btu)				-0.03	-0.12	
TOTAL DIRECT ENERGY (BARRELS OF OIL)[5]	17,504,419	24,314,434	25,236,414	24,517,270	22,288,628	
Change from Existing Direct Energy (Barrels of Oil)		6,810,016	7,731,995	7,012,851	4,784,209	-258,798
% Change in existing Direct Energy (Barrels of Oil))		0.39	0.44	0.40	0.27	
Change from No-Project Direct Energy (Barrels of Oil)				202,836	-2,025,807	-258,798
% Change in No-Project Direct Energy (Barrels of Oil)				0.01	-0.22	
Change from No-Project Direct Energy (5% increase in energy consumption factor) (Barrels of Oil)				-719,144	-2,947,787	

% Change in No-Project Direct Energy (5% increase in energy consumption factor) (Barrels of Oil)	[redacted]	[redacted]	[redacted]	-0.03	-0.12	[redacted]

Notes:
[1]From Table A-2.
[2]Calculated using Energy Consumption Factors from the *Transportation Energy Data Book: Edition 22* by the Oak Ridge National Laboratory, as follows:

Automobile: 5,669 Btus/VMT
Commercial Aircraft: 334,086 Btus/VMT.

[3]Calculated using 924,384 Btus/VMT. Energy Consumption Factor determined based on 400m EMU Type ICE 3 16-car trainset (Source: DE Consult 2003); converted from kilowatt-hours (kWh) using a 1-kWh per 12,458-Btu conversion to account for generation, transmission, and AC/DC conversion losses (Page E-18 *Energy Transportation Systems*).
[4]Calculated using Energy Consumption Factor for automobiles that is 5% larger than reported by Oak Ridge National Laboratory (ORNL). This is an example of how congestion might affect energy consumption. 105% of the ORNL-reported energy consumption factor for automobiles is 5,952.45 Btus/VMT.
[5]Btu to Barrel of Oil Conversion: 1 Barrel of Oil = 5.8 million Btus (U.S. Department of Energy. Office of Transportation Technologies, Transportation Energy Data Book: Edition 22 - 2002).
[6] Calculated using Energy Consumption Factor determined based on 400m EMU Type ICE 3 12-car trainset (Source: DE Consult 2003); converted from kilowatt-hours (kWh) using a 1-kWh per 12,458-Btu conversion to account for generation, transmission, and AC/DC conversion losses (Page E-18 *Energy Transportation Systems*).

DIRECT ENERGY CONSUMPTION PER PASSENGER-MILE TRAVELED (PMT)

To calculate the energy consumed per PMT, the annual energy consumption by each of the vehicle modes was divided by the corresponding annual PMT. The number of annual passenger trips expected to occur on each of the modes as a result of the implementation of the HST Alternative and the average trip length per passenger-trip for each mode were used to calculate the PMT values. Table A-4 shows the development of energy consumption per PMT for each of the modes.

Table A-4: Energy Consumption per Passenger-Mile Traveled

Mode	Passenger trips[1]	Average Passenger Trip Length[2]	PMT	(Btus[3]/PMT)[2]
Sensitivity Analysis Case				
Auto (Intercity)	151,834,252	250[5]	37,958,562,973	2,400
Auto (Commute)	10,000,000[4]	51[5]	509,207,783	5,700
Air	256,245	403[6]	103,266,915	3,300
High-Speed Train	68,397,253	264[7]	18,051,735,735	1,200
Investment Grade Case				
Auto (Intercity)	166,732,135	250[5]	41,683,033,831	2,400
Auto (Commute)	10,000,000[4]	51[5]	509,207,783	5,700
Air	10,194,713	403[6]	4,108,469,410	3,300
High-Speed Train	42,001,428	246[7]	10,322,062,262	1,800

Notes:
[1]For the HST Alternative scenario. From Table A-1.
[2]Rounded.
[3]See Table A-3 for these values.
[4]Change from No-Project.
[5]Derived from Paul Taylor (pers. com. Kaku) 2003.
[6]From Business Plan.
[7]Derived by multiplying the change from No-Project Passenger Trips by Passenger Trip Length for each of the conventional modes (including both intercity and commute auto), summing those values, and divided by HST Passenger Trips to get an average passenger trip length based on the length of the passenger trips being diverted to HST from the conventional modes.

INDIRECT ENERGY CONSUMPTION

The information presented in Table A-5 represents best estimates of construction energy consumption for each of the modes under consideration. In rural areas, it is assumed that the energy use for HST System construction would be similar to that used for track construction for a typical heavy rail system. In urban areas, the construction of the HST System would be similar to the energy consumption by BART. Table A-6 shows the length of HST System construction that would occur within rural and urban settings for each of the grade types. It is based on a total number of track-miles that will be laid per the Authority's Business Plan. The proportion of rural verses urban construction environments represented in the table is based on visual interpretation of the alignment in the context of the *California Atlas & Gazetteer* (DeLorme 2000). Table A-7 represents the anticipated energy consumption by mode and by system alternative. Estimates are for comparison purposes—true values are not known at current level of planning.

Table A-5: Construction Energy Consumption Intensity

Mode	Grade	Intensity (billions Btus/One-Way Guidway-Mile & Btus/finite facility)	
		Rural	Urban
Highway	At-	17.07	26.28
	Above-	130.38	327.31
Airport	Runway	6,312	
	Terminal	78	
HST	At-	12.29	19.11
	Above-	55.46	55.63
	Cut-	117.07	163.14
	Tunnel	117.07	328.33
	Station	78	

Table A-6: Rural vs. Urban HST Construction

Region	Percentage		Length of Structure (Miles)													
			Aerial			At-grade			Trench			Tunnel			Grand Total
	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	
HST BayArea-Merced	*70*	*30*	48.49	33.95	14.55	322.08	225.45	96.62				95.41	66.78	28.62	465.98
LA-Bakersfield	*70*	*30*	42.00	29.40	12.60	179.63	125.74	53.89	5.54	3.88	1.66	37.64	26.35	11.29	264.81
LA-Orange-SanDiego	*30*	*70*	22.48	6.74	15.73	128.50	38.55	89.95	18.94	5.68	13.26	29.14	8.74	20.39	199.05
LA-Riv-SanDiego	*60*	*40*	88.73[1]	53.24[1]	35.50[1]	109.47	65.68	43.79				31.81	19.09	12.72	230.01
Sac-Bake	*95*	*5*	45.19	42.93	2.26	711.41	675.84	35.57							756.61
		HST Total	246.89	166.26	80.64	1,451.09	1,131.27	319.82	24.48	9.56	14.92	193.99	120.96	73.03	1,916.46
Modal (Highway)	65	35	700	455	245	2,270	1,476	795							

[1]Includes following track lengths in LA-Riv-San Diego Region where it has not been determined whether they would be aerial or at-grade:
Total: 25.21miles
Rural: 15.13 miles
Urban: 10.09 miles

Table A-7: Indirect Energy Consumption

Mode	Grade	Facility Quantity		Energy Consumption (MMBtus)				
		Rural	Urban	Rural	Urban	Total	Total by Mode	Total by Alternative
Highway	At-	1,476	795[1]	25,187,000	20,879,000	46,066,000		
	Above-	455[1]	245[1]	59,323,000	80,191,000	139,514,000	185,580,000	
Airport	Runway	6				37,872,000		
	Terminal	91				7,098,000	44,970,000	230,550,000
HST	At-	2,263[2]	640[2]	27,807,000	12,224,000	40,030,000		
	Above-	333[2]	161[2]	18,442,000	8,972,000	27,413,000		
	Cut-	19[2]	30[2]	2,239,000	4,868,000	7,107,000		
	Tunnel	242[2]	146[2]	28,322,000	47,958,000	76,279,000		
	Station	20				1,560,000	152,390,000	152,390,000

[1]One-way lane-miles.
[2]Guidway-miles.

INDIRECT ENERGY PAYBACK PERIOD

Table A-8 illustrates the amount of time that it will take to pay back the energy consumed during construction of the system alternatives. The total indirect energy that would be consumed with implementation of both of the system alternatives is divided by the energy savings that is expected in 2020 (project minus No-Project/No-Action Alternative) for each of the alternatives to obtain the number of years it would take to recuperate the energy consumed during construction.

Table A-8: Payback Period

Alternative	Indirect Energy Consumption (Change from No-Project MMBtus)	Direct Energy Consumption (Change from No-Project, MMBtus)	Payback Period (Years)
Sensitivity Analysis Case			
Modal Alternative (non-congested)	230,550,000	1,176,000	196[2]
Modal Alternative (w/ 5% No-Project)	230,550,000	-4,171,000	-55
HST Alternative (non-congested)	152,390,000	-30,717,000[1]	-5
HST Alternative (w/ 5% No-Project)	152,390,000	-36,064,000[1]	-4
Investment Grade Case			
Modal Alternative	230,550,000	1,176,000	196[2]
Modal Alternative (w/ 5% No-Project)	230,550,000	-4,171,000	-55
HST Alternative	152,390,000	-11,750,000[1]	-12
HST Alternative (w/ 5% No-Project)	152,390,000	-17,097,000[1]	-9

[1]Includes energy savings from long-distance commuter diversion to HST.
[2]Positive number results from more energy being consumed by the Modal System Alternative than the non-congested No-Project/No-Action Alternative. In this scenario, energy consumption with the Modal Alternative from construction would never be paid back.

HST ELECTRICITY CONSUMPTION

The high-speed train system for the HST Alternative would consume about 74.2 kWh of electricity per train-mile, assuming implementation of a 16-car trainset, which would be required for the Sensitivity Analysis ridership forecasts. Per the Business Plan, high-speed trains in the HST system are anticipated to travel about 71,602 miles per day, indicating a daily electricity consumption of 5,312,904 kWh with a 16-car trainset. With a 12-car trainset, which would be required to accommodate the Investment Grade ridership forecasts, the high-speed train system would consume about 63.1 kWh of electricity per train-mile, which, while traveling 71,602 miles per day, would indicate a daily electricity consumption of 4,515,968 kWh. The electricity consumption for the Investment Grade case was based on a refinement of the 16-car trainset energy use assumption, where the amount of energy used by a 12-car trainset was assumed to be 85% of the amount used by a 16-car trainset. Table A-9 shows the Business Plan's Operations Plan.

Table A-9: HST Operations Plan

Service Type	Daily Trainset Trips	Frequency[1] (Trains per Hour)		Headway (Hours)[2]	
		Peak	Off-peak	Peak	Off-peak
Express	20	1.82	0.91	0.55	1.10
Semi-Express	12	1.09	0.55	0.92	1.83
Suburban Express	20	1.82	0.91	0.55	1.10
Local	12	1.09	0.55	0.92	1.83
Regional	22	2.00	1.00	0.50	1.00

[1]Based on Business Plan Operations Plan: approximately 6 operational hours at peak-period frequency and 10 operational hours at off-peak-period frequency on weekdays. Assumed peak-period frequency that is twice that of off-peak-period frequency.
[2]Inverse of frequency.

Table A-10 shows the derivation of the percentage of energy consumed during each frequency period by service type. This percentage is used in the derivation of the electricity demand estimate in Table A-11, below.

Table A-10: Percentage of Train Hours Traveled (THT)

Service Type	Express			Semi-Express			Suburban-Express			Local			Regional			Total
Frequency Period	Peak	Off-peak	Total	Peak	Off-peak	Total	Peak	Off-peak	Total	Peak	Off-peak	Total	Peak	Off-peak	Total	
Roundtrip Trip time (hours)[1]	5.5	5.5		6.5	6.5		6.5	6.5		6.9	6.9		2.0	2.0		
Headway[2] (hours/train)	0.6	1.1		0.9	1.8		0.6	1.1		0.9	1.8		0.5	1.0		
Instantaneous # trainsets on track[3]	10.0	5.0	15.0	7.1	3.5	10.6	11.8	5.9	17.7	7.5	3.8	11.3	4.0	2.0	6.0	60.7
Operational Duration (hours/day)[4]	6.0	10.0		6.0	10.0		6.0	10.0		6.0	10.0		6.0	10.0		
THT/Day[5]	60.0	50.0	110.0	42.5	35.5	78.0	70.9	59.1	130.0	45.2	37.6	82.8	24.0	20.0	44.0	444.8
Percentage of Total THT/day for Each Period of Operation	55%	45%	100%	55%	45%	100%	55%	45%	100%	55%	45%	100%	55%	45%	100%	
Percentage of Total THT/day for Total Daily Operation	13%	11%	25%	10%	8%	18%	16%	13%	29%	10%	8%	19%	5%	4%	10%	100%

[1]Calculated by averaging long-distance (non-regional) "Express Travel Times" from Table 2.2 of Authority's Business Plan for the Express Service. Additional time for Semi-Express, Suburban Express, and Local Services were estimated. Regional Service was calculated by averaging short-distance "Express Travel Times" from Business Plan (Table 2.2).

[2]From Table A-9.

[3]It is assumed that there is a set number of trainsets in operation at anyone time for each service type.

[4]Based on Business Plan Operations Plan.

[5]Assumes that the instantaneous number of operational trainsets remains constant for the duration of the both of the operational periods. Calculated by multiplying the instantaneous number of operational trainsets by the duration of the corresponding operational period.

Electricity demanded by the HST system during peak operating frequency coincides with the normal peak-period of electricity demand, which, in California, generally falls between 3 p.m. and 5p.m. on an August day. A 16-car trainset system would demand on the order of 480 MW during the peak period of electricity demand. Each 16-car trainset would demand on the order of 12 MW during operation. A 12-car trainset system would demand on the order of 410 MW during the peak period of electricity demand. Each 12-car trainset would demand on the order of 10 MW during operation. Table A-11 shows how electricity demand was derived for the system and by trainset for each of the ridership forecast scenarios.

Table A-11: Electricity Demand by Period for HST system and by Trainset

Service Type	Frequency Period	Percentage of Daily System Operation[1,2]	Energy Consumption per Period[1] (kWh)	Period Duration (hours)	Electricity Demand by Period[1,3] (kW)	Electricity Demand by Period[1] (MW)	Electricity Demand per Trainset[1,4,5] (MW)
Sensitivity Analysis Case							
Express	Peak	13%	716,669	6	119,445	119	12
	Off Peak	11%	597,224	10	59,772	60	12
Semi-Express	Peak	10%	508,183	6	84,697	87	12
	Off Peak	8%	423,486	10	42,349	42	12
Suburban Express	Peak	16%	846,972	6	141,162	141	12
	Off Peak	13%	705,810	10	70,581	72	12
Local	Peak	10%	539,456	6	89,909	90	12
	Off Peak	8%	449,547	10	44,955	45	12
Regional	Peak	5%	286,667	6	47,778	48	12
	Off Peak	4%	238,890	10	23,889	24	12
TOTAL	**Peak**	**55%**	**2,897,948**	**30**	**482,991**	**483**	**12**
	Off Peak	**45%**	**2,414,956**	**50**	**241,496**	**241**	**12**
Investment Grade Case							
Express	Peak	13%	609,168	6	101,528	102	10
	Off Peak	11%	507,640	10	50,764	51	10
Semi-Express	Peak	10%	431,956	6	71,993	72	10
	Off Peak	8%	359,963	10	35,996	36	10
Suburban Express	Peak	16%	719,926	6	119,988	120	10
	Off Peak	13%	599,939	10	59,994	60	10
Local	Peak	10%	458,538	6	76,423	76	10
	Off Peak	8%	382,115	10	38,211	38	10
Regional	Peak	5%	243,667	6	40,611	41	10
	Off Peak	4%	203,056	10	20,306	20	10
TOTAL	**Peak**	**55%**	**2,463,255**	**30**	**410,543**	**411**	**10**
	Off Peak	**45%**	**2,052,713**	**50**	**205,271**	**205**	**10**

[1]Rounded.
[2]Derived in Table A-10. The values in this column were multiplied by the total system energy consumption of 5,312,904 kWh for the Sensitivity Analysis case and 4,515,968 kWh for the Investment Grade case to obtain the values in the column, titled, "Energy Consumption per Period."
[3]Consumption was integrated over one hour to get average electricity demand by dividing the energy consumption per period by the number of hours in that period.
[4]Calculated by dividing the electricity demand by the instantaneous number of trainsets that are on the track within the frequency period of each service type. The instantaneous numbers of trainsets on the track can be found in Table A-10.
[5]16-car trainset for Sensitivity Analysis Case and 12-car trainset for Investment Grade Case.